

CLAIMS

What is claimed is:

1. A depalletizing apparatus for separating and transporting a collection of stacked objects from a stack, said apparatus comprising:

a suction device assembly for lifting an edge portion of a stack of objects in a substantially vertical direction;

a probing tongue for insertion into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said stacked objects above the probing tongue define a collection of stacked objects; and

a lifting blade for vertically lifting said collection of stacked objects.

2. The apparatus of claim 1, further comprising a compression device assembly for applying a downward compression force on an uppermost stacked object.

3. The apparatus of claim 1, further comprising a stack sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said edge portion.

4. The apparatus of claim 1, further comprising a tongue sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said probing tongue.

5. The apparatus of claim 1, wherein said suction device assembly includes one or more suction cups.

6. The apparatus of claim 1, wherein said suction device assembly is moveable both horizontally and vertically.

7. The apparatus of claim 1, wherein said lifting blade is moveable both horizontally and vertically.

8. The apparatus of claim 1, wherein said compression device assembly is moveable both horizontally and vertically.

9. The apparatus of claim 1, wherein said lifting blade includes at least two forks, said forks being horizontally moveable to one another.

10. A depalletizing apparatus for separating and transporting a collection of stacked objects from a stack, said apparatus comprising:

a suction device assembly for lifting an edge portion of a stack of objects in a first direction;

a probing tongue for insertion into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said stacked objects above the probing tongue define a collection of stacked objects;

a lifting blade for lifting said collection of stacked objects in a direction substantially similar to said first direction; and

a compression device for applying a downward compression force on an uppermost stacked object for stabilizing said collection during movement of the collection.

11. The apparatus of claim 10, wherein said first direction is substantially vertical.

12. The apparatus of claim 10, wherein said lifting blade is moveable into said stack following said probing tongue.

13. The apparatus of claim 10, further comprising a stack sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said edge portion.

14. The apparatus of claim 10, further comprising a tongue sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said probing tongue.

15. The apparatus of claim 10, wherein said suction device assembly has one or more suction cups.

16. The apparatus of claim 10, wherein said suction device assembly is moveable both horizontally and vertically.

17. The apparatus of claim 10, wherein said lifting blade is moveable both horizontally and vertically.

18. The apparatus of claim 10, wherein said compression device is moveable both horizontally and vertically.

19. The apparatus of claim 10, wherein said lifting blade includes at least two forks.

20. The apparatus of claim 19, wherein said forks are horizontally moveable to one another.

21. A depalletizing apparatus for separating and transporting a collection of stacked objects from a stack, said apparatus comprising:

a suction device assembly for lifting an edge portion of a stack of objects in a first direction;

a probing tongue for insertion into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said stacked objects above the probing tongue define a collection of stacked objects; and

a lifting blade for lifting said collection of stacked objects in a direction substantially parallel to said first direction;

wherein the probing tongue is moveable into the stack for creating an opening in a side of the stack for insertion of the lifting blade by the advancement of said lifting blade against the probing tongue.

22. The apparatus of claim 21, further comprising a compression device for applying a downward compression force on an uppermost stacked object.

23. The apparatus of claim 21, further comprising a stack sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said edge portion.

24. The apparatus of claim 21, further comprising a tongue sensor mounted adjacent said suction device assembly for determining a position of said suction device in relation to said probing tongue.

25. The apparatus of claim 21, wherein said suction device assembly has one or more suction cups.

26. The apparatus of claim 21, wherein said suction device is moveable both horizontally and vertically.

27. The apparatus of claim 21, wherein said lifting blade is moveable both horizontally and vertically.

28. The apparatus of claim 22, wherein said compression device is moveable both horizontally and vertically.

29. The apparatus of claim 21, wherein said lifting blade includes at least two forks, said forks being horizontally moveable to one another.

30. A robotic assembly for separating and transporting a collection of stacked objects from a stack, said robotic assembly comprising:

a robotic mechanism providing a range of motion;

a frame connected to said robotic mechanism;

a suction device assembly for vertically lifting an edge portion of a stack of objects, the suction device assembly connected to said frame;

a lifting blade operably connected to said frame; and

a probing tongue operably connected to said frame, said probing tongue moveable into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said objects above said probing tongue define a collection of stacked objects.

31. The robotic assembly of claim 30, further comprising a compression arm assembly operably connected to said frame, said compression arm assembly configured for applying a downward compression force on the stack of objects.

32. The robotic assembly of claim 30, further comprising a stack sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said edge portion.

33. The robotic assembly of claim 30, further comprising a tongue sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said probing tongue.

34. The robotic assembly of claim 30, wherein said suction device assembly includes one or more suction cups operably coupled to a suction producing source.

35. The robotic assembly of claim 30, wherein said suction device assembly is operable both horizontally and vertically.

36. The robotic assembly of claim 30, wherein said suction device assembly is comprised of a lifting arm and one or more suction cups connected to said lifting arm.

37. The robotic assembly of claim 30, wherein said lifting blade is operable both horizontally and vertically.

38. The robotic assembly of claim 31, wherein said compression arm assembly is operable both horizontally and vertically.

39. The robotic assembly of claim 30, wherein said lifting blade includes at least two forks, said forks being horizontally moveable to one another.

40. A robotic assembly for separating and transporting a collection of stacked objects from a stack, said robotic assembly comprising:

a robotic mechanism providing a range of motion;

a frame connected to said robotic mechanism,

a suction device assembly for vertically lifting an edge portion of a stack of objects in a first direction, the suction device assembly connected to said frame;

a lifting blade operably connected to said frame;

a probing tongue connected to said frame, said probing tongue moveable into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said objects above said probing tongue define a collection of stacked objects; and

a compression arm assembly operably connected to said frame, said compression arm assembly configured for applying a downward compression force on the stack of objects.

41. The robotic assembly of claim 40, wherein said first direction is substantially vertical.

42. The robotic assembly of claim 40, further comprising a stack sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said edge portion.

43. The robotic assembly of claim 40, further comprising a tongue sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said probing tongue.

44. The robotic assembly of claim 40, wherein said suction device assembly includes a lifting arm and one or more suction cups mounted on said lifting arm.

45. The robotic assembly of claim 40, wherein said suction device assembly is operable both horizontally and vertically.

46. The robotic assembly of claim 40, wherein said suction device assembly includes one or more suction cups operably coupled to a suction producing source.

47. The robotic assembly of claim 40, wherein said lifting blade is operable both horizontally and vertically.

48. The robotic assembly of claim 41, wherein said compression arm assembly is operable both horizontally and vertically.

49. The robotic assembly of claim 40, wherein said lifting blade includes at least two forks, said forks being horizontally moveable to one another.

50. A robotic assembly for separating and transporting a collection of stacked objects from a stack, said robotic assembly comprising:

a robotic mechanism providing a range of motion;

a frame connected to said robotic mechanism;

a suction device assembly connected to said frame, said suction device assembly for vertically lifting an edge portion of a stack of objects;

a lifting blade operably connected to said frame; and

a probing tongue connected to said lifting blade, said probing tongue moveable into said stack at a position at or below said suction device assembly, such that after insertion into said stack, said objects above said probing tongue define a collection of stacked objects.

51. The robotic assembly of claim 50, further comprising a compression arm assembly operably connected to said frame, said arm configured for applying a downward compression force on the stack of objects.

52. The robotic assembly of claim 50, further comprising a stack sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said edge portion.

53. The robotic assembly of claim 50, further comprising a tongue sensor mounted on said suction device assembly for determining a position of said suction device assembly in relation to said lifting blade.

54. The robotic assembly of claim 50, wherein said suction device assembly includes a lifting arm and one or more suction cups mounted on said lifting arm.

55. The robotic assembly of claim 50, wherein said suction device assembly is operable both horizontally and vertically.

56. The robotic assembly of claim 50, wherein said suction device assembly includes one or more suction cups operably coupled to a suction producing source.

57. The robotic assembly of claim 50, wherein said lifting blade is operable both horizontally and vertically.

58. The robotic assembly of claim 51, wherein said compression arm assembly is operable both horizontally and vertically.

59. The robotic assembly of claim 50, wherein said lifting blade includes at least two forks, said forks being horizontally moveable to one another.

60. A method for separating and transporting a collection of stacked objects from a stack, said method comprising the steps of:

vertically lifting an edge portion of a plurality of objects in a stack by utilizing a suction force, said stack having an uppermost stacked object;

inserting a probing tongue into said stack at a position at or below said vertically lifted edge portion, such that after insertion into the stack, the stacked objects above said probing tongue define a collection of stacked objects, and such that an opening in a side of the stack is made;

inserting a lifting blade into said opening; and

vertically lifting said collection of stacked objects with said lifting blade.

61. The method of claim 60, wherein said suction force is applied by a suction device assembly.

62. The method of claim 61 further comprising the step of:

determining a position of said suction device assembly in relation to said edge portion for maneuvering said suction device assembly towards said stack.

63. The method of claim 61 further comprising the step of:

determining a position of said probing tongue in relation to said suction device assembly for maneuvering said lifting blade towards said suction device assembly.

64. The method of claim 60, further comprising the step of:

applying a downward force on said stacked objects to compress said collection of stacked objects.

65. The method of claim 64, wherein the downward force is applied by moving a compression arm coupled to a compression foot downward on the collection of stacked objects.

66. The method of claim 60, wherein the stacked objects are from the group consisting of stacked cardboard boxes, stacked paper and stacked cartons.

67. The method of claim 60, further comprising the step of:

retracting said probing tongue from said stack after said lifting blade has been inserted into said stack.

68. The method of claim 60, further comprising the step of:

retracting said probing tongue from said stack while said lifting blade is being inserted into said stack.

69. The method of claim 60, further comprising the step of:

transporting said collection of stacked objects at away from said stack.

70. The method of claim 60, further wherein the probing tongue is pushed into said stack by the lifting blade.

71. A method for separating and transporting a collection of stacked objects from a stack, said method comprising the steps of:

lifting an edge portion of a plurality of objects in a stack in a first direction by utilizing a suction force, said stack having an uppermost stacked object;

inserting a probing tongue into said stack at a position at or below said lifted edge portion, the stacked objects above said probing tongue defining a collection of stacked objects;

inserting a lifting blade into said stack near the position of said probing tongue further lifting the probing tongue;

applying a downward force on said uppermost stacked object to compress said collection of stacked objects; and

lifting said collection of stacked objects with said lifting blade in said first direction.

72. The method of claim 71, wherein said suction force is applied by a suction device assembly.

73. The method of claim 71 further comprising the step of:

determining a position of said suction device assembly in relation to said edge portion for maneuvering said suction device assembly towards said stack.

74. The method of claim 71 further comprising the step of:

determining a position of said probing tongue in relation to said suction device assembly for maneuvering said lifting blade towards said suction device assembly.

75. The method of claim 71, wherein the downward force is applied by moving a compression arm and a compression foot downward on the collection of stacked objects.

76. The method of claim 71, wherein the stacked objects are from the group consisting of stacked cardboard boxes, stacked paper and stacked cartons.

77. The method of claim 71, further comprising the step of:

retracting said probing tongue from said stack after said lifting blade has been inserted into said stack.

78. The method of claim 71, further comprising the step of:

retracting said probing tongue from said stack while said lifting blade is being inserted into said stack.

79. The method of claim 71, further comprising the step of:

transporting said collection of stacked objects at away from said stack.

80. The method of claim 71, further wherein the probing tongue is pushed into said stack by the lifting blade.

81. The method of claim 71, wherein the first direction is substantially vertical.